Feed the Future Innovation Lab
For *Collaborative Research on Nutrition* - Africa
Tufts University - Annual Report - Year 4

Feed the Future Innovation Lab

For Collaborative Research on Global Nutrition

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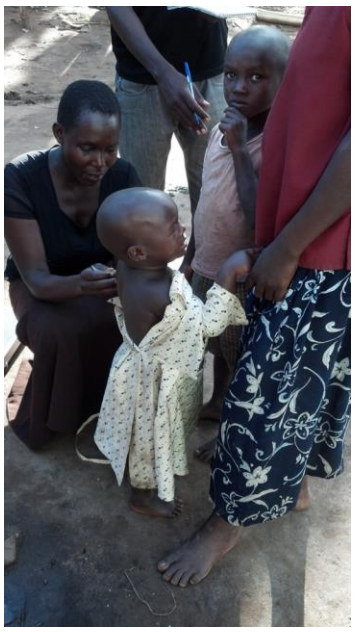
Annual Report
FY 2014 (Year 4)



Submitted by the Management Entity:
Friedman School of Nutrition Science and Policy
Tufts University
Boston

Feed the Future Innovation Lab

For Collaborative Research on Global Nutrition

USAID FROM THE AMERICAN PEOPLE

Tufts UNIVERSITY Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

Feed the Future Innovation Lab
For Collaborative Research on Nutrition - Africa

Annual Report FY 2014 (Year 4)

Management Entity Information

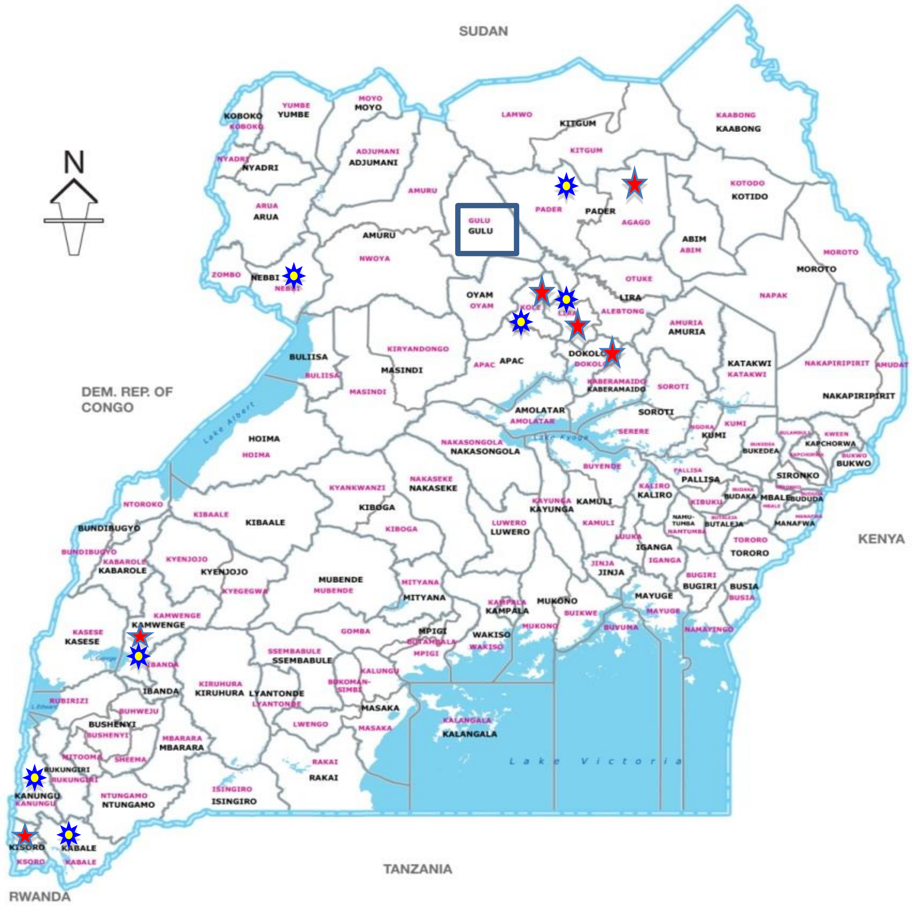
Tufts University's Friedman School of Nutrition Science and Policy is the Management Entity for the Feed the Future Innovation Lab for Collaborative Research on Nutrition – Africa (hereafter called the Nutrition Innovation Lab – Africa). Its activities are funded under grant contract AID-OAA-L-10-00006 from the United States Agency for International Development (USAID).

Core Management Team	Position	Email Address
Jeffrey K. Griffiths	Program Director	Jeffrey.Griffiths@tufts.edu
Eileen Kennedy	Co-PD	Eileen.Kennedy@tufts.edu
Shibani Ghosh	Assoc. Director, Technical	Shibani.Ghosh@tufts.edu
Florence Turyashamererwa	Local coordinator, Uganda	Florence.Kinyata@tufts.edu
Liz Marino-Costello	Program Manager	Elizabeth.Marino-Costello @tufts.edu

Global Technical Advisory Committee Information

Technical Advisory Committee	Position	Institution	Email Address
Shakuntala Thilsted	External advisor	Senior Nutrition Advisor, WorldFish Center, Bangladesh	sht@life.ku.dk
Richard Deckelbaum	External advisor	Director, Institute for Human Nutrition, Columbia University	rjd20@columbia.edu
Ram Shrestha	External advisor	Founder and Director, Nepalese Technical Advisory Group (NTAG)	ramntag@gmail.com
Shelley Sundberg	External advisor	Senior Program Officer, Bill and Melinda Gates Foundation	Shelley.Sundberg@ gatesfoundation.org
Ann Tutwiler	External advisor	Bioversity, Rome	a.tutwiler@cgiar.org
Stephen Vosti	External advisor	Faculty, University of California, Davis	svosti@ucd.edu
Barbara Seligman	Core partner representative	Technical Area Manager, Health, Development Alternatives, Inc.	Barbara_Seligman@dai.com
Maura Mack	Agreement Officer's Representative (AOR	Nutrition Advisor, USAID BFS	mmack@usaid.gov
Ahmed Kablan	Activity Manager	International Nutrition & Public Health Advisor USAID, BFS	akablan@usaid.gov

Map indicating Uganda study sites



Baseline with repeat panel surveys

Longitudinal Birth cohort sites and Process research

Gulu Birth cohort study

Research Activities:

1. Repeated Panel Survey Sites (Baseline Survey, Year 3): North: Agago, Dokolo, Kole, Lira, Southwest: Kisolo, Kamwenge. Agriculture, Nutrition, Health surveys conducted in collaboration with Makerere University, Harvard School of Public Health, Tufts University, IFPRI
2. Longitudinal Birth Cohort Sites: North: Pader, Nebbi, Lira, Kole, Southwest: Kanungu, Kabale, Kamwenge in collaboration with Makerere University, Harvard School of Public Health, Tufts University, IFPRI
3. Supported Birth Cohort Doctoral Research Site in Gulu in collaboration with Gulu University, Tufts University, Cornell University (via doctoral student support)
4. Process Research Sites: Kampala (national level analyses), Pader, Nebbi, Lira, Kole, Kanungu, Kabale and Kamwenge

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List of Program Partners

US Partners

- Harvard University
- Purdue University
- Tuskegee University
- Johns Hopkins University
- Boston University (informal partner)
- University of Illinois (water; informal partner)
- Virginia Tech University (microbiome analyses; informal partner)
- University of Georgia (aflatoxin assays; contractual partner)
- Development Alternatives, Inc. (DAI)
- International Food Policy Research Institute (IFPRI)
- National Aeronautical and Space Agency (NASA)
- SPRING (informal; MOU in process)

Uganda-based Partners

- Makerere University: School of Agriculture and Nutrition Sciences
- Makerere University: School of Public Health
- Gulu University
- FHI360 (Uganda Community Connector Project)
- Government of Uganda districts and ministries
- National Agriculture Research Centre

Malawi Based partners

- Bunda College, Lilongwe University of Agriculture and Natural Resources (LUANAR)
- University of Malawi, College of Medicine, Malawi
- Department of Nutrition, HIV and AIDS, Office of the President, Malawi
- Ministry of Health, Malawi

Other international partners

- LCIRAH (Leverhulme Centre for Integrated Research on Agriculture and Health - University of London)
- UNICEF (sharing of resources and knowledge in Uganda and Malawi)
- Food and Agriculture Organization (FAO) – technical support in Malawi
- Heifer International
- AusAID (for Timor Leste study of aflatoxins)
- University of Jakarta (for Timor Leste study of aflatoxins)
- University of Georgia (for aflatoxin analyses)
- St Johns Medical College, Bangalore, India (BBNC)

Acronyms

ACBT - Aquagenx Compartment Bag Test
AusAID- Australian Agency for International Development
BBNC - Bangalore-Boston Nutrition Collaborative
BIFAD - Bureau for International Food, Agriculture and Development
DAI - Development Alternatives Inc.
DHS - Demographic and Health Survey
ECD - Early Childhood Development
GAIN - Global Alliance for Improved Nutrition
GU - Gulu University
HSPH - Harvard School of Public Health
HI - Heifer International
HKI - Helen Keller International
IITA - International Institute of Tropical Agriculture
IFPRI - International Food Policy Research Institute
LCIRAH- Leverhulme Centre for Integrated Research on Agriculture and Health (University College London)
Makerere - Makerere University
NGO - Non-governmental agency
NASA - National Aeronautical and Space Agency
UCCP - Uganda Community Connector Project
UNICEF -United Nations Organization for Children
UN/SCN-United Nations Standing Committee on Nutrition
UGA - University of Georgia, Athena
UIC- University of Illinois, Chicago National Science Foundation Water Research Center

I) Executive Summary

The following is the annual report of the Feed the Future Innovation Lab for Collaborative Research on Nutrition in Africa (Nutrition Innovation Lab – Africa), for the fiscal year 2014 starting October 2013 through September 2014 ("Y4").

The Nutrition Innovation Lab-Africa seeks to discover how investments in agriculture can be enhanced to accelerate gains in nutrition, and how policy and program interventions can more effectively integrated to cost-effectively achieve improvements in maternal and child nutrition at scale. It also pursues innovative research at the frontiers of biology and policy, such as exploring the links between aflatoxins and nutrition outcomes, the role of livestock promotion in enhancing diet quality, and the links between sanitation (open defecation practices) and nutrition outcomes. Combining resources from Uganda, US institutions, and global partners the research and capacity building activities of the Nutrition Innovation Lab focus on operationally and policy-relevant work that supports both national government and USAID priorities.

Tufts University's Friedman School of Nutrition Science and Policy serves as the Management Entity for the Nutrition Innovation Lab in Africa and in Asia. The Friedman School implements the two Innovation Labs in close partnership with several US university partners including Tuskegee, Purdue, Johns Hopkins, and Harvard School of Public Health as well as the private sector development entity, Development Alternatives, Inc. (DAI). This core team manages the research and capacity-building resources in a manner that will allow for the generation of:

- Empirical evidence of what works in leveraging agriculture for improved nutrition through multi-sector programming, and
- Enhanced institutional and human capacity in Africa to conduct research and implement integrated nutrition activities in future years.

Nutrition Innovation Lab - Africa's vision of success is a set of robust empirical findings that can be quickly translated into policy and practice. We aim for our work to support enhanced outcomes globally not just locally, as new findings are adopted nationally and regionally. Furthermore, we hope our research platform can synergistically help other research entities with related goals.

In Y4, our Africa research focused on continued rigorous assessments and operations research around specific integrated livelihoods, agriculture and nutrition intervention, i.e. the USAID Uganda Community Connector (UCC). The UCC customizes livelihoods, agriculture and nutrition interventions based upon a district-level needs assessment and the Nutrition Innovation Lab - Africa has the unique opportunity to evaluate the effectiveness of this tailored approach, as well as the process of implementation itself. It is also an opportunity for the Nutrition Innovation Lab to test empirically the pathways linking agriculture to nutrition and health. In addition to the activities around the UCC, the Nutrition Innovation Lab-Africa also supported ancillary research activities that support our research strategy in the realm of nutrition, health and agriculture. Collaborative efforts with other Feed the Future Research Innovation Laboratories and international development actors have been or are in the process were established.

The Nutrition Innovation Lab-Africa responded to requests for applications (RFAs) resulting in Associate Awards from USAID/BFS and USAID/Egypt and buy-ins to the Leader with Associates Award from USAID/Malawi and USAID/East Africa. The Malawi award helps the Nutrition Innovation Lab-Africa focus on developing the capacity in Malawi for the development and implementation of an accredited Dietetics program and the compilation of a food composition table as well as the review of medical school curricula for nutrition content. The activities in Egypt focus on providing the Egyptian government and the Mission support around the analyses of policies that are likely to affect the double burden of malnutrition, secondary analyses of existing data around the relationship of stunting and obesity and examining the contribution of aflatoxin exposure and environmental enteropathy towards the risk of stunting and obesity. Support from BFS and the USAID/East Africa has allowed the Nutrition Innovation Lab-Africa to develop systems in the birth cohort study and the Gulu cohort to collect samples for the analysis of aflatoxins (to be finalized in FY 2015).

Human and Institutional capacity building activities were an equally important part of the Nutrition Innovation Lab-Africa agenda. A total of 21 Ugandan students were supported (18 MS or MPH; 2 PhD; 1 postdoctoral). Of these, 12 will continue with support in FY2015. Nine completed their studies in FY2014. 1 previously unsupported student began studies in FY2014. Seventy presons were involved in standard short-term training relating to data collection and surveys (61), BBNC participation (6), or short-term summer training (3). One hundred and fourteen persons used Nutrition Innovation Lab-Africa developed curricula delivered either as short-term training (110) or as a short-term intensive course (10). We continued to support Malawian partners on curriculum development for graduate degree nutrition programs in Malawi through a buy-in mechanism which will convert to an Associate Award in FY2015.

II) Program Activities and Highlights

The Nutrition Innovation Lab-Africa's research in Uganda went to scale during 2013/2014. A second full round of data collection for the panel survey was developed for implementation and all preliminary activities to implement the birth cohort study were completed. Significant secondary econometric analyses continued as did analysis of data from the Gulu cohort study. Capacity building included support to MS students (via Tuskegee); the finalization of the theses of the students supported in the prior years in Uganda; as well as the development of capacity at Bunda College in Malawi around the development and implementation of an accredited Dietetics program.

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Specifically within the context of the core award (Uganda), the following sections provide an overview of the program activities and accomplishments.

Second Panel Survey

Data collection for the first (baseline) panel survey began in 6 Districts near the end of FY2012 (Y2) and continued into FY2013 (Y3). Three of the 6 districts were Uganda Community Connector (UCC) 'Phase I' districts where intervention is commencing, and 3 are UCC 'Phase 2' districts where no intervention had been undertaken. The second panel survey data collection will be initiated in October 2014 (start of FY2015). Our representative survey was initiated in the two major agro-ecological zones in the UCC Project. This round of research will take advantage of findings from our first round of panel survey information, initial data from the cohort study and qualitative data from the implementation research. If possible, assessments of water quality and aflatoxin exposure will also be added to the panel survey. In FY 2014 (3rd and 4th quarter), the Nutrition Innovation Lab worked on the first panel questionnaires; fine tuning and pre-testing the questionnaires; IRB approvals/extensions were requested; and supervisors and enumerators were recruited in July/August 2014. As of September 30, 2014, training of enumerators for the data collection had been held and all the preliminary work including district visits and sensitization had been accomplished. It must be noted that the second panel is being led by Dr. Nassul Kabunga, our Ugandan Post Doctoral fellow at IFPRI.

Prospective Birth Cohort Study

To address the complex nature of infant and young child nutrition, the Nutrition Innovation Laboratory Africa team has undertaken an observational birth cohort study in districts where the UCC is active, and in districts where the UCC is not active. Study activities such as finalizing of the protocol, questionnaires, questionnaire tests, IRB submissions and approvals, review of the sub-counties and the "cold-chain" system were accomplished in the first two quarters of FY 2014. In the third quarter, job descriptions were developed for supervisors and enumerators, 20 supervisors were identified and hired and trained in July 2014 (First master training), and supply and equipment purchases were initiated. This was followed by the interviewing and hiring of enumerators on the ground, district sensitization visits, development and testing of the cold chain in the North and South followed by a second master training of supervisors and a training of enumerators. At the end of FY 2014, the teams were deployed out to the different sub-counties to start pre- recruitment activities. The first recruitment is anticipated to begin in the first quarter of FY 2015.

Exploring Neglected Biological Mechanisms: Aflatoxin related research

Funds received from the USAID BFS Associate Award (see associate award section) were utilized for the collection, handling and analysis of samples for serum aflatoxin levels in the prospective birth cohort study and funds received from USAID/East Africa are being used to analyze the samples from the Gulu cohort. (Barnabas Natamba, a Gulu faculty member and PhD student at Cornell University whom we support, conducted the Gulu study). Samples will be transported to an appropriate laboratory for analysis, and batch-assayed in order to reduce costs and reduce inter-assay variance[1]. Similar activities were also accomplished in Timor Leste (funded by UNICEF and AUSAID) in collaboration with the Nutrition Innovation Lab-Asia, University of Georgia and University of Jakarta (Indonesia). It is anticipated that given the agro-ecological differences between the Northern and Southern regions of Uganda, and the different seasons of delivery, significant variation in mycotoxin exposure is likely to exist. Thus it is anticipated that one serum sample from mothers and 3 from infants (birth, 6 months and 12 months) will be utilized for aflatoxin assessment. Opportunities to study the relationships between maternal aflatoxin ingestion, infant birth weight, and infant growth, as well as the role of HIV and food insecurity are being examined in the Gulu Cohort (see Associate Award from USAID East Africa). This work is ongoing.

Exploring Neglected Biological Mechanisms: Water Quality and WASH-related Assessments

The Nutrition Innovation Lab-Africa collaborated (June, 2013) with the University of Illinois' National Science Foundation Water Center in pilot testing and validating a field friendly water quality test kit made by the Aquagenx company against standard bacterial monitoring systems. In preliminary testing, the Aquagenx kit proved more sensitive for the detection of microbial contamination than standard testing, and suggested that water stored within households is more heavily contaminated than source waters. It also maps on a qualitative level to WHO risk categories (safe, low risk, moderate risk, high risk, and very high risk). In FY 2014, these

[1] Negotiations with the laboratory which has conducted assays for the Peanut and Mycotoxin Innovation Lab have been undertaken after discussions with other potential partners in the UK and the US.

compartment bags were ordered and transported to Uganda for use in a sub-sample of households recruited for the prospective birth cohort. Tufts University researchers are expected to train the field team in FY 2015 to conduct the tests.

Econometric analyses of secondary data

In FY 2014, Purdue University continued work on the Uganda National Household Survey (UNHS), the Uganda Demographic and Health Survey (DHS) data, and remote sensing satellite data. The latter are maximum value Advanced Very High Resolution Radiometer (AVHRR) Normalized Difference Vegetation Index (NDVI) composites from the NASA Global Inventory Monitoring and Modeling Systems (GIMMS) group at NASA's Biospheric Sciences Branch. These data have been supplemented with agricultural commodity price data from Uganda with both spatial and temporal resolution. Two publications have been accepted for publication based on these secondary analyses in FY 2014.

Exploring food security and nutrition outcomes in vulnerable populations

The Gulu cohort study examining the associations between food security and nutritional status in pregnant women with and without HIV continued in its post-natal phase. Gulu University activities continued through FY 2014 with planned analyses of banked samples for micronutrient status as well as aflatoxin assessment. Two publications and one oral presentation were the outputs for the Gulu University activities.

Multisectoral Coordination and Process Data Collection and Analysis

Activities continued around the question of multisectoral coordination and process research in Uganda. At the national level, interviews with policymakers and senior program staff were conducted by Tufts researchers in association with Ugandan collaborators in the second quarter of FY 2014. The findings are being finalized into a publication by Dr. Eileen Kennedy. At the other levels, the interviews will be conducted in conjunction with the second panel survey and cohort study roll-out (these will occur in FY 2015). The instruments used for this data collection will be designed collaboratively with the Nutrition Innovation Lab-Asia for reasons of comparability. All instruments and activities were approved by IRBs in the US and Uganda.

Table 1: Summary of Key Goals and Achievements for FY 2014

Research Plans	
Theme A: Understanding agriculture-nutrition linkages	
A.1 Empirically populating conceptual pathways from agriculture to nutrition outcomes	
➢ Second full round of household data collected in 6 UCC districts by Harvard, Makerere and Tufts- ACHIEVED (BRIDGES INTO YEAR 5)	ACHIEVED (Data Collection in FY 2015)
➢ Implementation of prospective birth cohort in 12 sub-counties in North and South West Uganda *Exploring neglected biological mechanisms linking food systems and nutrition* (BRIDGES INTO YEAR 5)	PARTIALLY ACHIEVED (Preparatory Work Completed FY2014; Recruitment starts FY 2015)
➢ Collection of serum samples for aflatoxins in both panel survey and cohort study (funds permitting)	ONGOING
➢ Analysis of aflatoxin links to nutrition from blood samples from Timor Leste	ACHIEVED
➢ Water quality assessments and possible collaboration with University of Illinois	ONGOING
A.2 Explore food security and nutrition outcomes in vulnerable populations	
➢ Continued analyses of data at Gulu University. Possible opportunity to analyze aflatoxin exposure in mother-infant pairs linking it to micronutrient status, food security and nutrition outcomes	ACHIEVED all FY2014 targets. ACHIEVED aflatoxin funding goal via East Africa Associate Award. ONGOING
➢ Pursuing opportunities and collaboration with Heifer International/Uganda to examine the role of animal source foods in improving food security and nutrition outcomes	NOT PURSUED (LACK OF FUNDING)
A.3 Econometric analyses of secondary data	
➢ Analysis of secondary Uganda datasets (nutrition linked to productivity, climate change) by Purdue	ACHIEVED FY2014 goals. ONGOING
Theme B and C: Understanding multisector programming for nutrition and policy and programming processes	
➢ First round of program exposure and service delivery surveys as part of the second panel survey	ONGOING
➢ National level interviews of key stakeholders.	ACHIEVED
➢ First round of program exposure and service delivery surveys as part of the prospective birth cohort	ONGOING
Publications	
➢ About 17 publications to be finalized (draft form and/or near submission)	PARTIALLY ACHIEVED

Human and Institutional Capacity Development Plans	
Long-term training	
➢ Publication and dissemination of Master's theses completed by 8 Masters students in Nutrition, Agriculture and Public Health in FY2014	PARTIALLY ACHIEVED (Dissemination in FY2015)
➢ Support for 1 Ugandan to receive graduate degree in Uganda, and 2 in Malawi	PARTIALLY ACHIEVED (lack of funds in Malawi)
➢ Support for 4 Ugandan students in the US (2 Masters students in Nutrition, 1 MPH, one Ugandan faculty matriculated to PhD position in Agricultural Economics) and for 1 PhD student in Uganda	ACHIEVED
➢ Half time support for a post-doctoral position (Ugandan) at IFPRI Uganda	ACHIEVED
Short-term training	
➢ One Ugandan faculty member will receive short term training in food processing (focus shift as faculty member desiring food processing training did not meet visa timelines)	ACHIEVED (in Public Health)
➢ Support 6 Ugandans to receive short-term (BBNC) training.	ACHIEVED
Institutional Development	
➢ Interactions with Gulu and Mbarara Universities for engagement in birth cohort studies	ONGOING
Governance Plans	
➢ Board of Directors and TAC meeting	ACHIEVED
➢ Management of planned External Review of the Nutrition Innovation Lab – Africa.	ACHIEVED
➢ Continued effective management of the innovation lab's resources.	ACHIEVED
➢ Dissemination of impactful research outputs via website, presentations, and publications	ONGOING

III) Key Accomplishments (2013/14)

<u>Theme A (Scientific Research)</u>

The first two targets identified under this theme were exceeded (see Table 2).

➢ We exceeded the target number of 26 (**36** actual) Uganda or US based institutions gaining enhanced capacity in nutrition research, monitoring and surveillance methodologies, nutrition information systems, and/or nutrition interventions with USG assistance. We have

successfully expanded our scope of activities to individual District administrations in Uganda, and brought in more US partners for our studies relating to remote sensing and WASH.

- The number of food consumption and/or nutrition surveys undertaken or reported on during FY14 totaled **22**, exceeding the number planned by 10. Because of our success in supporting student projects, the number of studies conducted, reported, or disseminated is higher than targeted. In FY2015 our main cohort study and a second panel study will be conducted, but the number of student projects conducted will decrease as some students completed their studies in FY2014.

Theme B (Human and Institutional capacity-building

- Third, the number of U.S. or host country institutions or individuals having completed a nutrition assessment, survey or gap analysis exceeded the target set (**43 completed** versus 12 target). Those individuals included the students we supported.

While data collection from the prospective birth cohort and the second panel were to start in FY 2015, several analyses are underway and a number of research papers and presentations were completed as planned during FY14.

- Research papers – 6 as reported in the Table of indicators (+6 additional papers) published, 1 additional Research Brief format, 13 MSc Theses (see Appendix 3).

- Dissemination of research findings. During FY14, Nutrition Innovation Lab-Africa collaborators (including local partners) made 35 presentations in a range of impactful venues. These are summarized in Appendix 2.

The Nutrition Innovation Lab-Africa's commitment to capacity building (improving host country academic, technical and research capacity in nutrition health and agriculture) was further strengthened through formal Board adoption of selection criteria for candidates seeking training support. All FY14 targets were met (Table 2 above).

- While the target for longer-term (graduate degree) training was 12, the final was 21 (15 Men and 6 women). A total of 20 were continuing students, 1 was new.
- In terms of the capacity building of individuals (through formal education and training programs), the Nutrition Innovation Lab-Africa supported 6 people with short-term trainings (at the Bangalore-Boston Nutrition Collaborative activity in India) as well as 184 people in other forms of trainings, posters and workshop settings.

Table 2: Nutrition Innovation Lab Africa Targets and Achievements (FY2014)

Theme (a): Scientific Research				
Outcomes	**Indicator Number**	**Output Indicators**	**FY 2014 Targets**	**FY 2014 Actuals**
Outcome 1: Improved host country nutrition and food security monitoring, analytics and surveillance capacities	N/CRSP 1	Number of U.S. and host country institutions that have gained enhanced capacity in nutrition research, monitoring and surveillance methodologies, nutrition information systems, and/or nutrition interventions with USG assistance	26	36
	N/CRSP 2	Number of food consumption and/or nutrition surveys undertaken, or reported on and disseminated	12	22
	N/CRSP 3	Number of U.S. or host country institutions or individuals having completed a nutrition assessment, survey or gap analysis.	12	43
Theme (b): Human and Institutional Capacity Development				
Outcomes	**Indicator Number**	**Output Indicators**	**FY 2014 Targets**	**FY 2014 Actuals**
Outcome 2: Improved host country academic, technical and research capacity in nutrition, health and agriculture	N/CRSP 4	Number of people trained in child health and nutrition (nutrition science, dietetics, public health nutrition) through USG supported programs (longer term – graduate school)	12	21 14 Men/6 Women (20 continuing: 1 new, all academic)
	N/CRSP 5	Number of people trained in child health and nutrition (nutrition science, dietetics, public health nutrition) through USG supported programs (short term – trainings, workshops)	100	184 (87 women/ 97 men) (80 Civil Society) (114 academic)
	N/CRSP 6	Number of US and host country institutions with enhanced capacity to assess, plan, design, implement, monitor and/or evaluate nutrition programs, policies and practices	12	46
	N/CRSP 7	Number of U.S. and host country *institutions and individuals* who have gained enhanced capacity in clinical, operational, agricultural, translational and/or public health nutrition research aimed at the reduction of malnutrition with USG assistance	138 (100 persons with enhanced capacity, 26 institutions 12 with longer-term training) (66 M 46 F	251 (93F, 111M)
	N/CRSP 8	Number of peer-reviewed journal articles co-authored with host country institutions and others in country with USG assistance (submitted or published)	10	6
	N/CRSP 9	Number of brief articles and presentations co-authored with host country institutions and others in country with USG assistance	20	35

IV) Theme A: Research Program Overview and Structure

The Nutrition Innovation Lab-Africa addresses three strategic high-level research questions including the understanding agriculture-nutrition linkages, how complex multi-sector programs work including examining the value of integrated programming and how policies and programs that support nutrition specific and sensitive actions can be enhanced to achieve their goals. The Innovation Laboratory Research Strategy is discussed within the context of three themes which are articulated in this section.

a. Understanding Agriculture-Nutrition Linkages

In what ways do investments in agriculture achieve significant measurable impacts in nutrition? As a corollary, can pathways to impact be empirically demonstrated?

Within this context we seek:

- Clarity on cause-and-effect pathways (agriculture-to-nutrition).
- Understanding what is the value added by including agriculture interventions while seeking to achieve nutrition goals, and its magnitude.
- Knowledge of what forms of agriculture investment have the greatest net nutrition impact. These could include enhanced productivity, better crop harvesting and storage, a diversified portfolio of activities, a greater focus on commercialization, more focus on home consumption of specific foods, or combinations thereof.

There are at least four main elements to the research on agriculture-nutrition linkages:

- Empirically populating conceptual pathways from agriculture to nutrition outcomes
- Exploring neglected biological mechanisms linking food systems, health and nutrition
- Exploring food security and nutrition outcomes in vulnerable rural populations with HIV
- Econometric analyses of secondary data linking agro-ecology, agriculture, food systems and nutrition

b. Understanding How Complex Multisectoral Programs Work: What is the Value of Integrated Programming?

How can large-scale programs best incorporate knowledge about agriculture's support for nutrition into cost-effective, multisectoral interventions aimed at improved nutrition?

The global Scaling Up Nutrition (SUN) movement proposes that "there is a need to incorporate nutrition interventions into smallholder agriculture and rural livelihoods programmes, for example through encouraging home production of foods like fruits and vegetables and animal products that are rich in nutrients"[2]. The logic underpinning such a prescription is the widely accepted idea that "the bulk of the poorest in the world are peasant farmers" [3] [4]and that actions

[2] SUN (Scaling Up Nutrition). 2011. *Progress Report from countries and their partners in the Movement to Scale Up Nutrition (SUN)*. Report to the United Nations High Level Meeting on Nutrition, September 20th, 2011. New York City, NY. Mimeo

[3] Dalyell, T. 2012. Sleep walking into global famine. Book review. *Food Security* 4: 675-6. Doi 10.1007/212571-012-0212-1.

[4] HTF (Hunger Task Force). 2005. *Halving Hunger: It Can Be Done.* Final Report of the Millennium Project Hunger Task Force to the U.N. Secretary General. New York: Millennium Project

combining agriculture with targeted health and nutrition activities can both amplify and accelerate gains in nutrition among that target rural population.

The bundling of multisectoral components into a linked portfolio of actions is often justified by claimed interaction effects [5]. Heaver (2005), focusing on World Bank activities, has argued, "…multisectoral programs are the most effective way to tackle malnutrition"[6]. The biggest problem is the lack of clear evidence-based guidance on how to do this, where it makes most sense, and how cost-effective such actions would be at scale compared with any alternative interventions. According to the World Bank (2010), understanding of complex interventions needs to be "enhanced by collecting data on service delivery, demand-side behavioral outcomes, and implementation processes to better understand the causal chain and what part of the chain is weak."[7]

The Nutrition Innovation Lab-Africa's research in this domain will focus on seeking to identify which "active ingredients" of USAID UCC have greater or lesser impact on health and nutrition outcomes, either singly or in combination with others. This represents 'implementation research' in that its intent is to investigate and address major bottlenecks (e.g. social, behavioral, economic, management) that impede effective implementation, test new approaches to improve multi-sector programming, as well as determine a plausible relationship between the intervention and its impact.[8] The Nutrition Innovation Lab-Africa team will aim to understand:

- Program fidelity (how well did actual intervention match program design?)
- Reasons for uptake of programmed resources at household level (exposure to ideas, services and assets; decisions to adopt/accept or not adopt/accept new practices or resources; constraints at individual, household, community, program levels)
- Effectiveness of program uptake (process tracing to determine what impact adoption/acceptance had on health and nutrition outcomes)
- Sustainability of program intent (duration, intensity of adoption/acceptance)
- Equity issues (socioeconomic and geographic distribution of coverage, exposure, adoption/acceptance, and impacts)

c. Understanding Policy and Programming Processes

How can policy and program implementation *processes* be enhanced to support nutrition-specific and -sensitive actions?

[5] Ravallion, M. 2013. Are we really assessing development impact? http://blogs.worldbank.org/impactevaluations/guest-post-by-martin-ravallion-are-we-really-assessing-development-impact 2012. Fighting Poverty One Experiment at a Time. Jou. Econ Lit. 50 (1): 103-14.

[6] Heaver R. 2005. *Strengthening country commitment to human development.* Washington, D.C.: World Bank

[7] World Bank. 2010. *What Can We Learn from Nutrition Impact Evaluations? Lessons from a Review of Interventions to Reduce Child Malnutrition in Developing Countries*. Independent Evaluation Group. Washington, D.C

[8] According to the US National Institutes of Health, the newly emerging field of implementation science "is the study of methods to promote the integration of research findings and evidence into…policy and practice. It seeks to understand the behavior of…professionals and other stakeholders as a key variable in the sustainable uptake, adoption, and implementation of evidence-based interventions." (NIH 2013)

There is little clarity on the most appropriate methodologies for process tracing or implementation research. This is particularly important since interventions do not operate in a vacuum. They are implemented in a context that has spatial, temporal, political, economic and other characteristics. According to Garrett et al. (2011), "an explicit, well-developed theory of working multisectorally does not exist, certainly not for nutrition."[9] A systematic review of the literature published between 1994 and 2007 on public health in developing countries concluded that analysis of how policies are implemented is "still in its infancy."[10] The authors of that review argued that much more understanding is needed "on implementation, and specifically, the challenges of implementing equity-oriented policies, as well as more examination of successful policy change experiences."

The study within the context of this theme aims to link measures of institutional and individual capacity to work across sectors at national and district government levels (multiple line ministries), with measures of program fidelity at local (sub-district and community) levels and human outcomes across the panel study and cohort study field sites. The capture of insights from stakeholders along the entire chain from central (government) level down to the beneficiary (household) represents a survey-based, in-depth, longitudinal prospective study of events as they unfold.

Key research questions that are likely to be addressed include:

1. What is the evidence base used by stakeholders in developing multi-sectoral policy and integrated activities in Uganda?
2. How are 'new' nutrition goals and actions aligned or added to other activities?
3. What collaborations pre-exist across sectors and how are they affected by proposed multisector policies and interventions?
4. What barriers, facilitators, and constraints affect collaboration, resource flows and implementation of proposed policies and program elements?
5. What effect do organizational culture, institutional resourcing and individual capabilities have on effective implementation and level of 'readiness to change' from a management perspective?
6. How do differing levels of autonomy and responsibility affect collaboration?
7. Does employment stability (length of stay in a position/experience) affect individuals' knowledge, attitudes and practices in their job?
8. What incentives and dis-incentives for collaboration exist at various organizational levels and across ministries and agencies?
9. What resources can be accessed at different levels (financial, social, intellectual) to support collaboration, learning, innovation and effective implementation?
10. What is the role of gender equality and women's empowerment, equal access to resources and land in relation to effective implementation?

[9] Garrett J and M Natalicchio (eds.). 2011. *Working multisectorally in nutrition: principles, practices, and case studies*. Washington, D.C. International Food Policy Research Institute.
[10] Gilson L and N Raphaely. 2008. The terrain of health policy analysis in low and middle income countries: a review of published literature 1994–200 *Health Policy and Planning* 23 (5): 294-307. doi: 10.1093/heapol/czn019

V) Theme A: Research Activity Reports

The Nutrition Innovation Lab - Africa and its research team (Harvard, Makerere, Tufts including our post doctoral fellow at IFPRI) are involved in primary data collection underpinning its research for Theme A. We are collecting district, household and individual level data, using both district panel surveys and a birth cohort study. Additional studies are being conducted (e.g. Gulu University, Purdue University) that will respond to the research questions under Theme A. Tufts University, using tools developed by Nutrition Innovation Lab - Asia to allow for best comparison, will take the lead in the 'implementation' research focused on Theme B and C. The implementation research to address Theme B will include household level variables as well as institutional variables and will be conducted in collaboration with Harvard School of Public Health and Makerere University. The implementation research to address Theme C will include national, district and parish level assessments. Tufts will lead on the national level assessments working closely with other initiatives that are planning similar activities.

V.1.1 Research Theme a. Conceptual Pathways around Agriculture, Nutrition and Health

Second Panel Survey

Data collection for the first baseline panel survey began in 6 Districts near the end of FY2012 (Y2) and continued into FY2013 (Y3). Thus the second panel survey has been designed to collect data in the same calendar year time frame. Three districts were Uganda Community Connector (UCC) 'Phase I' districts where intervention had commenced, and 3 were UCC 'Phase 2' districts where no intervention had been undertaken. The second panel survey will be initiated in October 2014 (start of FY2015). Our representative survey was initiated in the two major agro-ecological zones in the UCC Project. This round of research will take advantage of findings from our first round of panel survey information, initial data from the cohort study and qualitative data from the implementation research. If possible, assessments of water quality and aflatoxin exposure will also be added to the panel survey. In FY 2014 (3rd and 4th quarter), the Nutrition Innovation Lab-Africa worked on the first panel questionnaires; fine tuning and pre-testing the questionnaires. IRB approvals/extensions were requested and supervisors and enumerators were recruited in July/August 2014. As of September 30, 2014, training of enumerators for the data collection had been held and all the preliminary work including district visits and sensitization had been accomplished. It must be noted that the second panel is being led by Dr. Nassul Kabunga, our Ugandan Post Doctoral fellow at IFPRI.

Prospective Birth Cohort Study

To address the complex nature of infant and young child nutrition, the Nutrition Innovation Laboratory-Africa team has undertaken an observational birth cohort study in districts where the UCC is active, and in districts where the UCC is not active. The study design will allow the comparison of sub-counties with active UCC intervention (Phase 1 and 2) versus those with no UCC intervention. The birth cohort study is targeted to intensively study pregnant women, the children they bear, and their households[11]. Data will be collected across 9 time points (2 time

[11] Because pregnant women and young children are sensitive to inputs, which change nutrition and health, they are an ideal target group for studying the impact of agriculture, nutrition, and health interventions. Outcomes can be assessed at the household and individual level, and process indicators such as UCC program fidelity and delivery can be studied at the household, sub-parish, and district levels. Prospective birth

points in pregnancy and 7 from birth through 24 months). Outcome measures will include pregnancy weight gain, anemia, biochemical indices (e.g. maternal micronutrient and protein status) and birth weight of infants. Infant follow ups will allow for collection of outcome measures including anthropometric status, health and morbidity outcomes as well as biomarkers of micronutrients and protein. It is anticipated that one serum sample from mothers and 3 from infants (birth, 6 months and 12 months) will be collected for biomarker analyses. The prospective nature of a birth cohort makes the design robust and helps elucidate the causality links of interventions. The birth cohort and the panel surveys are mutually reinforcing, study methodologies that will help the Nutrition Innovation Lab-Africa address two of three key research questions.

Study activities such as finalizing the protocol, questionnaires, questionnaire tests, IRB submissions and approvals, review of the sub-counties and the "cold-chain" system were accomplished in the first two quarters of FY 2014. In the third quarter, job descriptions were developed for supervisors and enumerators and required equipment and supplies were purchased. In the third quarter, 20 supervisors were identified, hired, and trained in July 2014 (First master training). This was followed by the interviewing and hiring of enumerators on the ground, district sensitization visits, development and testing of the cold chain in the North and South followed by a second master training of supervisors and a training of enumerators. At the end of FY 2014, the teams were deployed to the different sub-counties to start pre- recruitment activities. The first recruitment is anticipated to begin in the first quarter of FY 2015.

Exploring Neglected Biological Mechanisms: Aflatoxin-related research

Funds received from the USAID BFS Associate Award (see associate award section) are being utilized for the collection, handling, and analysis of samples for serum aflatoxin levels in the prospective birth cohort study and funds received from USAID/East Africa are being used to analyze the samples from the Gulu cohort. A cold chain was established in Uganda, including the purchase of a -80^{o}C freezer for storage in Kampala. Multiple MOUs were signed with regional hospitals to collect, process, and store our samples from the birth cohort before transportation to Kampala. Samples will be transported to an appropriate laboratory for analysis, and batch-assayed in order to reduce costs and reduce inter-assay variance[12]. Such activities were accomplished in Timor Leste (funded by UNICEF and AUSAID) in collaboration with the Nutrition Innovation Lab-Asia, University of Georgia and University of Jakarta (Indonesia). Because maternal exposure to aflatoxins is believed to affect birth weight, a maternal sample before or at the time of delivery would help assess this causal pathway. Similar information, also from prior CRSP (now Innovation Lab)-funded studies in Ghana, suggests a linkage between maternal mycotoxin exposures and maternal anemia. Infant serum aflatoxin levels obtained at 16 weeks of age in West Africa have been shown to be predictive of future adverse growth as measured at 1

cohorts are a 'gold standard' study approach, which allows comparisons across national boundaries as well as within a country. The prospective nature of a birth cohort also helps to address the issues of causality. This serves the Nutrition Innovation Laboratories research agenda, and the USAID goal of developing a global, evidence-based approach for allocating its resources.

[12] Negotiations with the laboratory which has conducted assays for the Peanut and Mycotoxin Innovation Lab have been undertaken after discussions with other potential partners in the UK and the US.

year of age.[13] In addition, infant aflatoxin levels increase significantly after weaning when they are exposed to complementary foods.[14] Both of these hypotheses are being prospectively addressed in the birth cohort. It is anticipated that given the agro-ecological differences between the Northern and Southern regions of Uganda, and the different seasons of delivery, significant variation in mycotoxin exposure is likely to exist. Thus it is anticipated that one serum sample from mothers and 3 from infants (birth, 6 months and 12 months) will be utilized for aflatoxin assessment. Opportunities to study the relationships between maternal aflatoxin ingestion, infant birth weight, and infant growth, as well as the role of HIV and food insecurity are being examined in the Gulu Cohort (see Associate Award from USAID/East Africa). This work is still ongoing.

Exploring Neglected Biological Mechanisms: Water Quality and WASH-related Assessments

Preliminary analysis on the baseline (n=3,630 households) shows high rates of lack of water treatment with 78% of households not treating their water, approximately 16% of households report boiling their water, and another 2.5% report treating water with chlorine or other agents. In addition, sources of water included both protected (n=2331) and unprotected (n=1299) sources. The Nutrition Innovation Lab-Africa collaborated (June, 2013) with the University of Illinois' National Science Foundation Water Center in pilot testing and validating a field-friendly water quality test kit made by the Aquagenx company against standard bacterial monitoring systems. In preliminary testing, the Aquagenx kit proved more sensitive to contamination than standard testing, and suggested that water stored within households is more heavily contaminated than source waters. It also maps on a qualitative level to WHO risk categories (safe, low risk, moderate risk, high risk, and very high risk). In FY 2014, these compartment bags were ordered and transported to Uganda for use in a sub-sample of households recruited for the prospective birth cohort. Tufts University researchers are expected to train the field team in FY 2015 to conduct the tests.

Econometric analyses of secondary data

In FY 2014, Purdue University continued work on the Uganda National Household Survey (UNHS), the Uganda Demographic and Health Survey (DHS) data, and remote sensing satellite data. The latter are maximum value Advanced Very High Resolution Radiometer (AVHRR) Normalized Difference Vegetation Index (NDVI) composites from the NASA Global Inventory Monitoring and Modeling Systems (GIMMS) group at NASA's Biospheric Sciences Branch. These data have been supplemented with agricultural commodity price data from Uganda with both spatial and temporal resolution. Two publications have been accepted for publication based on these secondary analyses in FY 2014.

Exploring food security and nutrition outcomes in vulnerable populations

The Gulu cohort study examining the associations between food security and nutritional status in pregnant women with and without HIV continues in its post natal phase. Gulu University activities continued through FY 2014 with planned analyses of banked samples for micronutrient status as

[13] Turner PC et al. Aflatoxin exposure in utero causes growth faltering in Gambian infants. International J Epidemiol 2007;36:1119-1125.
[14] Gong YY et al, Postweaning Exposure to Aflatoxin Results in Impaired Child Growth: A Longitudinal Study in Benin, West Africa. Environ Health Perspect 2004;112:1334-1338.

well as aflatoxin assessment. Two publications and one oral presentation were the outputs for the Gulu University activities.

V.1.2 Research Theme b and c: Multisectoral Coordination and Process Data Collection and Analysis

The Nutrition Innovation Lab-Africa's strategic questions include ones around the process of multisectoral implementation and coordination. The study is based on interviews with stakeholders defined at the national, sub-national, district, parish and village (field level service provision) levels. There is no 'representative' universe of stakeholders from which to draw a sample for such research. From a government perspective, relevant office-holders in 10 ministries or coordinating bodies at the central level, 8 at the meso-level (the main line ministries having some role to play in managing resources and activities that feed down to the relevant districts), and 3 at the micro level (implementers of government services at the community level) will be interviewed.

From a non-government perspective, a range of key donor and NGO organizations were identified as important actors in the appropriate policy and programming arenas (for example, as core members of the National Nutrition Group, having had a role in the development of UNAP [Uganda Nutrition Action Plan], and/or active engagement with donor-funded integrated programs) as well as academics directly involved in advisory, consulting or other collaborative capacities. At the meso and micro levels, relatively fewer institutional players are involved from the donor and academic perspective, so data collection focuses on line ministry and implementing NGO stakeholders.

At the national level, interviews with policymakers and senior program staff were conducted by Tufts researchers in association with Ugandan collaborators in the second quarter of FY 2014. The findings are being finalized into a publication by Dr. Eileen Kennedy . At the other levels, the interviews still need to be conducted in conjunction with the second panel survey and cohort study roll out (these will occur in FY 2015). The instruments used for this data collection will be designed collaboratively with the Nutrition Innovation Lab-Asia for reasons of comparability. All instruments and activities were approved by IRBs in the US and Uganda.

VI) Associate Award Research Project Reports

Two Associate Awards were made or imminent to the Nutrition Innovation Lab – Africa in Y4. These include one from USAID/BFS (Bureau of Food Security) and one from USAID/Malawi (imminent). In addition, there was a buy-in from USAID/East Africa to the Nutrition Innovation Lab-Africa Leader with Associates Award to support aflatoxin analyses on the Gulu pregnancy cohort. The Nutrition Innovation Lab-Africa also had extensive interactions with USAID/Egypt leading to a non-competitive RFA followed by a response from the Nutrition Innovation Lab-Africa with an Associate Award expected in FY 2015 (contractual discussions were ongoing as of the end of FY2014). In this section, we outline the activities under the Associate Awards and buy-in, and their status as of Sept 30, 2014.

VI.1.1 Malawi

In Malawi, the three major activities are:

- Development and implementation of a Dietetics program and building capacity at Bunda College of Agriculture to maintain program
- Review of medical school nutrition curricula
- Development of a national food composition table

Activities in Malawi continued through FY 2014. The Nutrition Innovation Lab-Africa responded to a non-competitive RFA from USAID/Malawi that will allow the Lab to continue these important activities in Malawi through the issuance of an Associate Award. A new proposal and workplan along with a budget were submitted by the Nutrition Innovation Lab-Africa to USAID/Malawi in July 2014. Subsequently, there were delays in issuing an Associate Award as well as changes in leadership within the local partner institution (LUANAR). The Nutrition Innovation Lab-Africa team (Elizabeth Marino Costello, Lynne Ausman, Shibani Ghosh and Jeff Griffths) along with USAID/Malawi (Violet Orchadson) and Bunda College (Dr. Agnes Mwangela) continued their interactions. However, on some of the activities (e.g., the Food Composition Table and Medical School Curricula) were temporarily deferred while the Associate Award was being processed.

Development and Implementation of a Nutrition & Dietetics Program

In Y3, a formal needs assessment and a courses review was conducted. In FY 2014, all courses were reviewed and revised. Complete syllabi including teaching objectives, reading materials and rubrics for assessment were finalized. Courses were developed by Tufts faculty as well as Bunda faculty. An application was submitted to the LUANAR Senate for formal approval of the Dietetics program (which was approved conditionally on September 30, 2014). Discussions have been held on the development of an application to the Medical Council of Malawi for accreditation of the program.

Review and Revision of Medical and Nursing School Curricula

The Nutrition Innovation Lab-Africa continued to work with local stakeholders in determining the best way to incorporate nutrition into the medical and nursing school curricula. Interactions in FY 2013 have led the Nutrition Innovation Lab-Africa to conclude that there is very little actual nutrition education within the medical school curricula. Specific findings are presented in the Y3 annual report.

In FY2014, the Nutrition Innovation Lab-Africa met with the College of Medicine in Blantyre (Professor Kenneth Maleta) and developed an MOU to be signed by Tufts and the College of Medicine that would allow for interactions around the medical school curriculum as well as the dietetics program. As of September 30, 2014, the Nutrition Innovation Lab-Africa was anticipating feedback from the College of Medicine. With respect to the medical school curriculum, one solution may be the issuance of national educational guidance from the Medical Council coupled with the inclusion of nutrition questions in qualifying exams. This approach would address the MOH concerns and allow educational institutions to develop separate nutrition curricula or to continue the practice of integration, as they see fit. The inclusion of nutrition questions on national qualifying exams would ensure that nutrition as a topic would be taught to the standards deemed necessary by the MOH.

Development of National Food Composition Tables

In FY 2014, the Nutrition Innovation Lab-Africa continued working on the development of the food composition tables. Our approach has been to identify and assess what data (specific to Malawi food patterns) exists, and to identify specific proximate analyses that would be needed to augment the existing data. In Y3, students compiled food lists for the six key food groups in Malawi. Next steps were to continue this compilation, and to locate and confirm the sources of existing composition data from the published or gray literature. Food databases for Malawi or East Africa will be sought. However, this activity did not advance significantly due to the lack of funds pending the issuance of the USAID/Malawi Associate Award. That being said, the Nutrition Innovation Lab-Africa held a series of meetings with FAO (which compiles the national food composition tables around the world under the INFOODS network) in Malawi as well as with the FAO team at a conference in Ghana. Of particular interest is the non-monetary support that FAO is willing to provide to designate the food composition tables being generated as a national food table. Furthermore, it is anticipated that FAO (INFOODS) will invite our Malawian collaborator, Dr. Agnes Mwangela, to be the INFOODS Coordinator for development of the Malawian food composition table.

VI.1.2 Associate Award: Egypt

In June 2013, Dr. Griffiths met with the USAID/Egypt Mission in Cairo to discuss the very high rates of obesity and rising stunting in Egypt. Subsequently, a request for a concept note was honored, and a revised concept note was requested (October 28, 2013). Revised concept notes were submitted in November 2013 and January 2014 following which the Nutrition Innovation Lab-Africa responded formally to an RFA request from USAID/Egypt. Through significant interactions, an Associate Award was issued. As of September 30, 2014, the Nutrition Innovation Lab-Africa was interacting with USAID/Egypt to determine the contractual obligations. The award will be finalized in early FY 2015 with activities beginning as soon as the agreement has been signed.

With respect to the activities associated with this award, the Nutrition Innovation Lab-Africa will build on existing knowledge, identifying and further elucidating the factors that affect childhood stunting in Egypt. The research and activities will examine biological, economic, agricultural, and policy linkages between linear growth, overweight and obesity, maternal nutrition, feeding practices and food subsidies. The roles of emergent causes of stunting, such as aflatoxins and enteropathy, will be incorporated into an analysis that identifies opportunities for obtaining key primary data. This will be accomplished through an in-depth mapping and literature review of policy initiatives and secondary analyses of existing data (e.g. DHS, the Household Food consumption and expenditure survey). Primary data collection studies will augment the findings of the policy review and secondary analyses.

The Nutrition Innovation Lab-Africa is also interacting with USAID/Egypt on developing capacity for aflatoxin analyses in Egypt through the Ministry of Health and Population utilizing samples from the DHS 2015.

VI.1.3 Associate Award: USAID/BFS (Aflatoxin research)

In the first quarter of FY 2014, the Nutrition Innovation Lab-Africa responded to an Associate Award RFA from USAID/BFS on aflatoxin research in Nepal and Uganda. The award was made in February 2014, and covers the analytical costs associated with analyzing 3500 samples for serum aflatoxin levels. In Uganda, the Nutrition Innovation Lab-Africa will utilize the existing platform of the birth cohort study. Data being collected from the cohort study includes demographics and socioeconomic status, maternal and child diet, water/sanitation/hygiene (including bacterial contamination of household water), breast feeding and complementary feeding practices, health status, food security and insecurity, gender and decision making, time allocation, access to agriculture/nutrition/health information and infrastructure, crop and livestock production, labor activities, other income sources, access and use of markets, agricultural technologies and management practices, biochemical markers of nutrition, hemoglobin and malaria status. We propose to also assess maternal and infant blood aflatoxin levels to assess the relationship(s) between aflatoxin exposure and adverse nutrition and health outcomes.

VI.1.4 Buy-in: USAID/East Africa

The Nutrition Innovation Lab-Africa interacted with the USAID/East Africa Regional Mission in FY 2013 and responded to a request for a scope of work to examine aflatoxin exposure in pregnant women and its effect on birth outcomes. The $100,000 USD buy-in to the Leader with Associates Award was made in FY 2014. The setting of the study is Gulu Hospital in Uganda where 400 women infant pairs are already enrolled in the ongoing Gulu longitudinal cohort study (supported by the core Nutrition Innovation Lab-Africa funding. The study is an adjunct to the ongoing observational cohort and will use banked serum samples to describe aflatoxin levels in mothers and infants, operationalized as aflatoxin albumin adduct (AFAA), and their association with HIV status and infant growth. The hypotheses to be tested include (quoted from the Award documents):

- **Aflatoxin exposure during pregnancy predicts maternal weight gain**. Data to be used will include the measured aflatoxin levels obtained from the 400 women during pregnancy and their weight gain during the pregnancy. Poor maternal weight gain is a key determinant of adverse birth outcomes such as preterm delivery, and small-for-gestational age or low birth weight. This relationship has not been addressed in prior studies.
- **Aflatoxin exposure during pregnancy predicts adverse birth outcomes and infant birth weight.** Data to be used will include the measured aflatoxin levels obtained from the 400 women during pregnancy, and birth outcomes from their 400 infants including infant birth weight and gestational age. Prior studies have not in, in general, prospectively assessed *in utero* aflatoxin levels and birth outcomes with the exception of Turner and colleagues. That study was conducted in West Africa, not East Africa, and had a sample size of 137 infants. Our study will link 400 women and 400 infants in the East African setting. This hypothesis is linked to the first hypothesis and we anticipate that the findings will be concordant, adding biological plausibility to the findings.
- **Maternal aflatoxin exposure during early infancy (the breastfeeding period) predicts early infant growth.** Data to be used will include the measured aflatoxin levels from 250

women obtained when the infant is 1 month of age, and the infant growth parameters (height and weight for age over time) up to when they are weaned. Maternal serum levels of aflatoxin will reflect their exposure, and through breast feeding, the exposures of their infants. We will also explore how predictive the combined maternal aflatoxin levels from pregnancy, and when their infants are 1 month of age are in explaining early infant growth. Again this has not been addressed in East Africa, and prior studies from West Africa have been of smaller size.

V1.1.5 Possible Award: Rwanda

In FY 2013, Nutrition Innovation Laboratory – Africa held a total of three meetings (2 in Kigali, 1 in Accra) with USAID/Rwanda team members. A concept note was submitted with a set of activities for discussion. The Rwanda Mission had informed us that once the National Nutrition planning activities were concluded in October 2013, they would re-engage with the Nutrition Innovation Laboratory – Africa on a possible Associate Award. As of Sept 30, 2014 (end of FY 2014), this has not occurred.

VII) Theme B: Human and Institutional Capacity Development

VII.1.1 Individual training

The Nutrition Innovation Lab-Africa continues to support Ugandan academics and students for both short-term and long-term support. Short-term support includes short courses and workshops:

- *Short-Term*:
  - Harvard School of Public Health hosted a Ugandan faculty member for short term training on nutrition and epidemiology. Details on the course and the experience of Dr. Agnes Nabubuya are presented in success story number 2.
  - Makerere University hosted a Nepali student, Dr. Robin Shrestha, who also worked extensively with the birth cohort team while conducting a case study in two districts in Uganda- KABALE in the Southwestern region and LIRA in the Northern region. The study investigated the effects of the UCC on improving the nutrition knowledge and dietary diversity of pregnant women who presented at the ante-natal care visits in the local health facilities. Success story 1 presents information on this Nepal-Uganda interaction.
- *Long –Term*:
  - As noted in the workplan of FY 14, the Nutrition Innovation Lab-Africa supported 8 students in FY 2012 and 2013 for their field projects and MS theses. Several of these have completed their theses (listed under publications) as well as have draft manuscripts.
  - 1 MSc student was supported at Makerere to conduct MPH nutrition studies (Ben Okia)
  - Continued support of two Ugandan Students (who graduated in May 2014) at Tuskegee University
  - Continued support for 1 Ugandan MPH student (Edgar Agaba) at Tufts University

- Continued 50% support for Dr. Nassul Kabunga as the Nutrition Innovation Lab-Africa Post doctoral fellow at IFPRI Uganda
- Continued PhD research support of Mr. Barnabas Natamba at Gulu University (and Cornell) for Uganda-based field research on food insecurity in pregnant HIV positive women

VII.1.2 Institutional development:

The Nutrition Innovation Lab-Africa worked with several institutions in Uganda and Malawi. For the prospective birth cohort, new collaborations were developed with local district hospitals (at least 8 MOUS have been signed). The Nutrition Innovation Lab-Africa continued its support of the Bunda College of Agriculture (LUANAR) and initiated an MOU with the College of Medicine, University of Malawi. At the end of FY 2014 (and going into FY 2015), the Nutrition Innovation Lab Management Entity (ME) spent considerable time with the DHS team, USAID/ Egypt, Ministry of Health and key nutrition institutions in Egypt to understand the potential for conducting aflatoxin analyses in country. This work will continue into FY 2015.

VIII) Technology Transfer and Scaling Partnerships

Unlike other Innovations Labs, which focus on generating new varieties of seeds, techniques for pest control or tools for market analyses, the Nutrition Innovation Lab Africa's main intellectual property relates to dissemination of research findings that directly impact policy and program design, and the methods of implementing both. The one technology transfer that may represent an important step forward in research in Uganda is the programming and use of electronic tablets for implementing surveys in the field. Documenting the process, cost and time-savings involved in tablet-based data collection will represent an important upgrading of local research capabilities in-country.

IX) Governance and Management Entity Activities

The ME tasks for Year 4 of the program were implemented smoothly by Tufts. Research and training funds were almost completely disbursed among the many partners. As planned and budgeted for in the Y4 workplan, the ME was able to successfully:

- Program Director of Africa served as the Chair for the Innovation Council extending his tenure for 3 months in order to smooth the transition of the Council from CRSP only Labs to all Feed the Future Innovation Labs. He then became a member of the Council Steering Committee to help provide continuity.
- Work with all the FTF Innovation Lab stakeholders in coming to a consensus on the mandate and membership of the Council.
- Organize field trips for, and interact extensively with, the External Evaluation Team (EET) tasked by USAID to review the Nutrition Innovation Labs in Africa and Asia, and offer recommendations regarding potential extension into a second phase and actions required to address weaknesses in areas of management, research, finances and/or capacity building. The ME responded formally to the overall positive evaluation report of the EET and thanks USAID for setting up and overseeing the review process.

- Host one Board of Directors and one Technical Advisory Committee (TAC) Meeting in September 2014. The TAC focused on examining the direction of the Nutrition Innovation Labs research in Africa and Asia, with a focus on successes and potential weaknesses identified by the EET. The Board of Directors (BOD) focused on potential future directions for the Nutrition Innovation Labs, and how to enhance dissemination of results so far.
- The Nutrition Innovation Labs' website was restructured and enhanced, with a formal 're-launch' planned for early in Y5. This responds to one of the important recommendations for the Nutrition Labs in the EET report.

In addition to the governance and management activities, key events were hosted by the Nutrition Innovation Lab-Africa in several global scientific meetings:

- The Nutrition Innovation Lab organized two successful Innovation Lab Directors' Council meetings – one in Kathmandu in March 2014, which brought together Mission representation from the region and high-level representatives from USAID/Washington; and the other in Washington, D.C., in September 2014, which also included a large reception in the Senate and interaction with staffers and congressional and senate representatives.
    - Organize the Nepal Council meeting including the organization of the symposium and field trips for participants of the Innovation Lab Directors' Council participants in Kathmandu (March 2014)
    - Organize a second Council meeting in Washington DC with the expanded group of FTF Innovation Labs
- Several other events, conferences and fora were used by the Nutrition Innovation Lab-Africa for the presentation and dissemination of research and capacity building activities. A list of events, presentations and the numbers reached are provided in Appendix 2.
- Work and support other Innovation Labs: The Nutrition Innovation Lab-Africa worked in close collaboration with the Peanut and Mycotoxin Innovation Lab around aflatoxin analyses (for East Timor and the other subsequent studies in Uganda). The Nutrition Innovation Lab-Africa also interacted extensively with and provided technical support to the Irrigation Innovation Lab in the development of nutrition questionnaires for their activities in Ethiopia.

X) Other Topics (impact assessment, gender initiatives)

Not applicable

XI) Issues (financial, management, regulatory)

In Year 4, the ME spent more than 60 percent of the total Nutrition Innovation Lab-Africa award on work in Uganda. Again, as in past years, the majority of the ME labor is allocated to cost share and is not part of the main labor budget. Key positions, such as the Associate Director and Program Manager, are provided as cost share. The majority of the funds were given to our partners to be used toward capacity building and research in-country. Some of the other major expenses related to costs associated with promoting and disseminating Nutrition Innovation Lab-

Africa research results, such as the workshop the ME sponsored at the Nutrition Congress in Spain. This year we sponsored 6 students from Uganda to attend the research workshop in India and 6 students to complete their MS theses (through Tuskegee).

XII) Future Directions

The core foci of the Nutrition Innovation Lab-Africa's research will continue into Y5. The longitudinal panel will continue to build, the policy process work will become sharper, and the other ongoing studies will bear fruit that informs the Feed the Future agenda. Furthermore, important analyses of secondary datasets continue and new elements (e.g., aflatoxin analyses in the prospective birth cohort and the Gulu cohort as well as Associate Award work in Egypt and Malawi) will enhance the Nutrition Innovation Lab-Africa's visibility and impact across Africa. Capacity building will remain central to the Nutrition Innovation Lab-Africa's agenda. Opportunities will continue to be explored now that the main activities have been awarded.

Appendix 1: List of awards to U.S. universities

1. *Harvard University: (*includes local partner Institute of Medicine), Mother-Infant Pair Follow Up, 2012 – 2014, $ $85,085 n Y4 ($562,503 total)

2. *Purdue University:* Understand and measure the connections between agricultural capacity, technology adoption, nutrition outcomes, and conditioning factors at levels of aggregation ranging from household to district level. $$79,584 in Y4 ($315,033 total)

3. *Tuskegee University:* $$83,758 in Y4 ($$218,830 in total)

Appendix 2: List of presentations made on Nutrition Innovation Lab – Africa research activities

Presenter	Event	Place	Title	Date	Size of Audience
Griffiths, Jeffrey K.	CRSP (later Nutrition Innovation Lab) Council Meeting	Ames, Iowa	Nutrition Innovation Lab – What we Do and Why	Oct 15 2013	30
	Tufts Global Health Seminar Series	Tufts Univ. School of Medicine	Unexpected Health and Nutrition Linkages to the Environment and Sanitation	Oct 22 2013	55
	Course: Nutrition and Immunity	Tufts Univ. School of Nutrition	Nutrition and Infection in Children	Oct 22 2013	14
	Carney Hospital Grand Rounds	Carney Hospital, Boston	Unexpected Health and Nutrition Linkages to the Environment and Sanitation	Oct 23 2013	60
(with Patrick Webb)	Nutrition Innovation Lab Partner Meeting	Tufts Univ, Boston, MA	Nutrition Innovation Labs - Research Activities Review	Dec 20, 2013	12
	University of Illinois Meeting with BFS, USAID	USAID, Washington, DC	Introduction to Nutrition Innovation Lab for Nutrition-Africa & the Safe Global Water Institute	Jan 17, 2014	12
	Makerere University IRB (Ethics Committee)	Kampala, Uganda	The Nutrition Innovation Lab – Africa Birth Cohort Study	Feb 4, 2014	18
(with Nassul Kabunga and Shibani Ghosh)	Meeting with USAID/Uganda	Kampala, Uganda	Smallholder Fruit and Vegetable Production Systems in Uganda: Effects on Household Food Security and Maternal Anemia	Feb 7, 2014	8
	American Association for the Advancement of Science (AAAS)	AAAS Meeting, Chicago, IL	Water, Sanitation, and the Prevention of Stunting: Why Food Isn't Enough	Feb. 15, 2014	75
	External Review	Tufts Univ., Boston, MA	Self-Assessment and Reflections	Feb. 20, 2014	8
	Massachusetts Institute of Technology Course: Water and Sanitation Infra-structure in Developing Countries	Cambridge, MA	Water, Sanitation, and the Prevention of Stunting: Why Food Isn't Enough	March 4, 2014	23
	Nepal Innovation Labs Meeting	Kathmandu, Nepal	Introduction to Innovation Labs	March 10, 2014	50
	Nepal Innovation Labs Meeting	Kathmandu Nepal	Food is Necessary … But Not Sufficient. Biological Insights into Malnutrition	March 11, 2014	50
	Course: Occupational and Environmental Health	School of Engineering, Tufts University, Medford MA	Environmental Enteropathy and Environmental Toxins as Occupational Hazards	March 236, 2014	15

	Launch of USAID US Global Development Lab	New York, NY	The Prevention of Stunting: Why Food Is Not Enough	April 3, 2014	>250
	Horticulture Innovation Lab Dissemination Meeting	Washington, DC	Fruit & Vegetable Production in Uganda: Greater F&V Consumption, Improved Food Security, Less Anemia	Aug 9, 2014	30
	Course: Biology of Water and Health	Tufts University, Medford MA	Waterborne Diseases	Sept 10, 2014	12
	Partnering Beyond the Health Sector: What is Needed to Ensure Maternal-Newborn Survival? (Millenium Development Goal Health Alliance; Save the Children; USAID Development Lab, Johnson & Johnson hosts)	Warton Forum, Convene New York, NY	Are changing environments influencing maternal and newborn health? (Session moderated by Liz Ford, Deputy Editor, Global Development, *The Guardian*	Sept 23, 2014	250
Kennedy, Eileen	pending				
Ghosh, Shibani	pending				
Ugandan partners	pending				
Additional Presentations	IN INDIVIDUAL PARTNER REPORTS				

Appendix 3: Papers produced during FY14

Published (reported in Table of Indicators)

1. Griffiths, JK and Kikafunda, J. 2014. Childhood Threats to Adult Cognition in sub-Saharan Africa: Malaria, Anemia, Stunting, Enteric Enteropathy, and the Microbiome of Malnutrition. In: "Brain Degeneration and Dementia in Sub-Saharan Africa" eds. Seggane Musisi and Stanley Jacobson. Springer Science+ Business Media. (in press).
2. Feed the Future Innovation Laboratory for Collaborative Research on Nutrition Africa. 2013. Assessing the Linkage Between Agriculture, Food Security, Nutrition and Health Among Women and Children in Rural Ugandan Households. Baseline Report, October 2013.
3. Kabunga, N. 2014. Improved Dairy Cows in Uganda: Pathways to Poverty Alleviation and Improved Child Nutrition. IFPRI Discussion Paper 01328. February, 2014.
4. Kabunga N, Ghosh S, Griffiths JK. 2014. Can Smallholder Fruit and Vegetable Production Systems Improve Household Food Security and Nutritional Status of Women? Evidence from Rural Uganda. IFPRI Discussion Paper 01346. April, 2014.
5. *Natamba BK,* Achan J, Arbach A, Oyok TO, Ghosh S, Mehta S, Stoltzfus RJ, Griffiths JK, Young SL. Reliability and validity of the center for epidemiologic studies-depression scale in screening for depression among HIV-infected and -uninfected pregnant women attending antenatal services in northern Uganda: a cross-sectional study. BMC Psychiatry (2014)
6. *Natamba, Barnabas K.*, Hillary Kilama., Angela Arbach., Jane Achan., Jeffrey K. Griffiths., Sera L. Young. Reliability and validity of an individually-focused food insecurity access scale for assessing inadequate access to food among pregnant Ugandan women of mixed HIV status. Public Health Nutrition (2014)

Publications (Not in Table of Indicators)

7. Masters W, Webb P, Griffiths J and Decklebaum R. 2014. Agriculture, Nutrition and Health in Global Development: Integrated Intervention Designs Call for Integrated Research Methods. Annals of the New York Academy of Sciences. doi: 10.1111/nyas.12352.
8. Shively, G. and J. Hao (2013) "Agricultural Activity and Child Growth in Uganda." Draft.
9. Omiat, G. and G. Shively (2013) "Spatial and Vertical Price Transmission for Selected Commodities and Markets in Uganda." 4Working Paper. West Lafayette (IN), Purdue University Department of Agricultural Economics.
10. Brown, Molly, Kathryn Grace, Gerald Shively, Kiersten Johnson and Mark Carroll. 2014. "Using Satellite Remote Sensing and Household Survey Data to Assess Human Health and Nutrition Response to Environmental Change." Forthcoming in Population and Environment.

11. Jagger, Pamela and Gerald Shively. 2014. “Land Use Change, Fuel Use and Respiratory Health in Uganda.” Energy Policy 67: 713-726.
12. Natamba, B., Achan, J., Oyok, T., Mou, S., Ghosh, S., Stoltzfus, R., Griffiths, J.K. & Young, S. (2014, April). Maternal food insecurity, anemia, and social support are independently associated with prenatal depression among HIV-positive and-negative women attending antenatal services in northern Uganda. The FASEB Journal, 28 (1 Supplement), 268-2.

Unpublished Reports and Briefing Papers

13. Webb P., S. Ghosh, S. Muslimatun, J-S Wang, S. Gurung and J. Griffiths. 2014. Nutrition Implications of Aflatoxin Exposure: An Analysis of Mothers and Children in Timor-Leste’s Food and Nutrition Survey. A report to UNICEF and Australian Aid, July 31, 2014.

MSc theses for Makerere Students (Published)

14. Oroma R. Factors Associated with Dietary Diversity among women of reproductive age (15-49 years) in Agago District. MSc thesis Makerere University
15. Providence H. Determinants of nutritional outcomes among children under five years of age in Uganda. MSc thesis Makerere University
16. Nambafu C. Factors associated with complementary feeding practices among children aged 6-23 months in Pader district. MSc thesis Makerere University
17. MSc Theses Abstract
18. Twinomujuni Rukambbura E. The relationship between men’s involvement in child feeding and nutritional status of children aged 6-59 months in Kihihi Kanunga district. MSc thesis Makerere University

MSc theses ongoing

19. Galiwango H. Effect of women’s participation in agricultural decision making on household food security: A case study of Luwero Sub-county in Luwero district. MSc thesis Makerere University
20. Ssemakula J. A critical path for developing millet orange sweet potato enriched porridges to improve access to nutrient dense complementary foods in Kasambya- Mubenda. MSc thesis Makerere University
21. Asiimwe E. Effectiveness of agricultural extension approaches in influencing nutrition knowledge and dietary practices among farming households: a case study of VEDCO in Mukono district, Central Uganda. MSc thesis Makerere University
22. Kansiime E. Significance of dietary guidance on caregiver’s food selection practices and nutritional status of children 6-18 months of age in Luwero district. MSc thesis Makerere University
23. Okia B. Prevalence and factors associated with underweight status in infants among Tororo district. MSc thesis Makerere University

24. Atim E. Complementary food handling practices affecting the food quality and nutritional status of children in Adyel division, Lira district. MSc thesis Makerere University
25. Akankiza SM. Dietary exposure to aflatoxin in maize and its relationship with stunting in children under five years of age from Ibanda district, Western Uganda. MSc thesis Makerere University
26. Kamarembo F. Nutrition education to increase consumption of Vitamin A rich foods in rural pregnant women in Ibanda district. MSc thesis Makerere University
27. Kato Kazibwe H. Estimation of Meat demand system in Uganda, an almost ideal demand system. MSc thesis Makerere University
28. Natukunda N. Investigating the level of weight for age among children 6-59 months: a case study of Kanungu district. MSc thesis Mukono University

Appendix 4

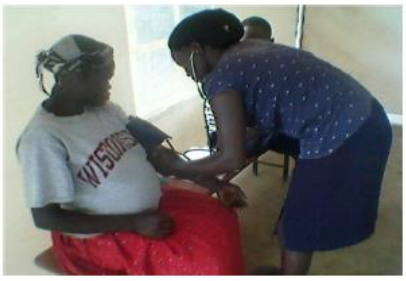
Success Story No. 1

Case Study looking into improvement of knowledge about nutrition and dietary diversity in pregnant women of rural Uganda
Robin Shrestha

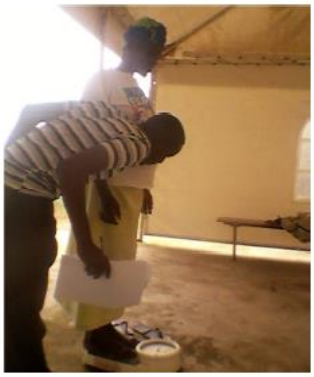
The Nutrition Innovation lab in Uganda seek to investigate the effects of Uganda Community Connector (UCC) project, a five year project focused to enable households to improve nutrition and sustainable livelihood security using nutrition sensitive and specific interventions. The Nutrition Innovation Lab birth cohort study aims to assess the effects of integration of agriculture and nutrition interventions of UCC by following up pregnant women and their offspring, from locations with and without UCC implementation.

In adjunct to the birth cohort, a case study was performed during the summer 2014, in two districts in Uganda- KABALE in the Southwestern region and LIRA in the Northern region. The two weeks study investigated the effects of UCC in improving the nutrition knowledge and dietary diversity of pregnant women who presented at the ante-natal care visits in the local health facilities. This cross sectional study enrolled 106 pregnant women aged 18 to 49 years with gestational age above 20 weeks from both districts. Data were collected from two health centers in each district, one with CC and one without CC implementation. The study utilized the established data collection platform developed by the Nutrition Innovation Lab partners (Tufts University and Harvard University) and host country institution (Makerere University). The findings will be presented to the Tufts faculty and the birth cohort research team in Uganda.

SOME PICTURES FROM THE STUDY



Jenifer, the Midwife from Agwata HCIII taking a BP for a respondent



Weighing in process

Visits made during the data collection helped solve some critical questions concerning the roll out of the birth cohort study. Issues regarding community blood draws activities; and its transport, processing and storage (cold chain transport) were raised during data collection visits to the health facilities for the case study. The assessment of the cold chain transport was successfully performed along with the data collection for the case study. Although collecting blood samples from remote regions in Uganda and transporting them to the facilities at appropriate timing for its viability for processing and storage has infrastructure (sample processing areas in health facilities, freezers, electricity) and human resource (phlebotomists, lab technicians) concerns, the

Nutrition Innovation Lab team in Uganda is able to achieve sufficient number of human resource within the community, utilize local facilities and provide necessary capacity building tools and training to improve health care skills and standards of the health facilities. The results from the case study will assist the birth cohort study team analyze preliminary information about maternal health, diets, nutrition outcomes and common pregnancy illnesses such as gestational hypertension. Information about how health services are provided in the field and what resources are available will be critical in successful implementation of the birth cohort This case study to assist in answering these issues and add an important step in successfully rolling out and implement the birth cohort study.

The NILA Uganda Birth Cohort Team

Success Story No.2

Summer Course attendance and Internship at Harvard School of Public Health

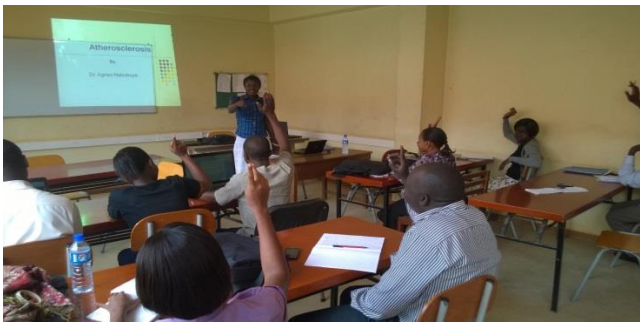
Dr. Agnes Nabubuya

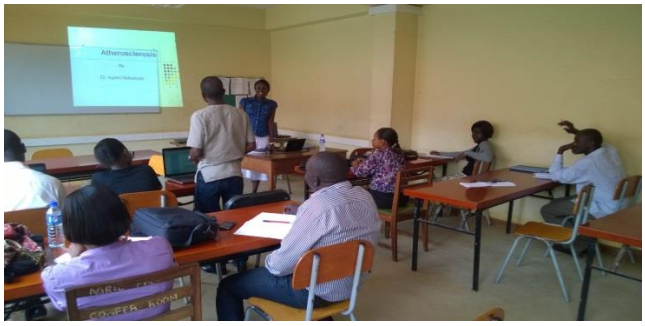
The Nutrition Innovation Lab-Africa awarded me support to attend Harvard School of Public Health summer program in Boston, MA. The four courses started in July 2014 and ended in August 2014. The courses included:

- Fundamentals of epidemiology (EPI 500)
- Introduction to Management (HPM 510)
- Global Nutrition (NUT 217)
- Infections Transmitted through Water and Food (IID 233)

I earned 10 credits. I passed all the courses and await my academic document, which I will share with my Nutrition Innovation Lab colleagues. The courses I pursued while at Harvard School Public Health have been very helpful to me in terms of improving my teaching in the following ways:

- I learned the importance of student participation method rather than one sided teaching method
- Utilization of students' presentation as one of the ways of material delivery methods
- Usage of evidence based teaching (using published articles to show the latest discoveries about particular topics
- Strengthen my knowledge of the latest research on linking nutrition to global health indicators.





MSC. Applied Human Nutrition class: Nutrition in Health and Disease; students participation in class

The opportunity to study at the Harvard School of Public Health in Boston was a wonderful opportunity for me to enhance my knowledge and teaching skills. I would like to thank members of the team for selecting me to take this opportunity. I am very grateful to you all and to USAID for funding the trip.